Kerala NMMS Science

Sample Paper – 3

Duration: 30 Minutes **Maximum Marks: 30**

Instructions

- This paper contains **30** Multiple Choice Questions (Single Correct Answer), modelled on the Science portion of **Kerala NMMS** (SAT).
- Each correct answer carries **+1 mark**. There is **no negative marking** for incorrect or unattempted answers.
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 7–8 (SCERT Kerala / NCERT) — Physics (Motion, Force & Pressure, Heat, Light, Sound, Electricity, Magnetism), Chemistry (Acids Bases Salts, Chemical Reactions, Metals & Non-metals, Carbon, Water, Air), Biology (Cell, Nutrition, Respiration, Transport, Reproduction, Microorganisms, Natural Resources).**
- Use of mobile phones, calculators, or electronic gadgets is strictly prohibited. Rough work may be done in the space provided.

Q1. In which medium does sound travel the fastest?

(A) Gases, because the particles are free to vibrate

(B) Liquids, because they are denser than gases

(C) Solids, because the particles are closely packed and transmit vibrations quickly

(D) Sound travels at the same speed in all media

Q2. Which of the following correctly defines **uniform motion**?

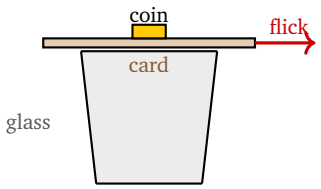
(A) The object accelerates uniformly in one direction

(B) The distance-time graph of the object is a curved line

(C) The speed of the object keeps increasing with time

(D) The object covers equal distances in equal intervals of time

Q3. The figure below shows a coin placed on a card that rests on top of a glass. When the card is flicked away sharply, the coin drops into the glass. Which property of matter best explains this observation?



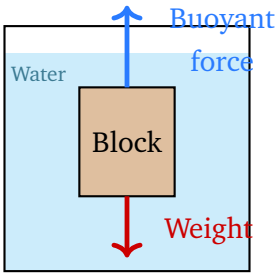
(A) Inertia of rest — the coin tends to remain at rest when the card is pulled away

(B) Centripetal force acting on the coin toward the centre of the glass

(C) Friction between the coin and the card pulling the coin along

(D) Buoyancy of the air pushing the coin downward into the glass

Q4. The figure shows a rectangular block submerged in water. Which statement correctly describes the **buoyant force** acting on the block?



(A) A downward force exerted by the water on the block

(B) An upward force exerted by the water equal to the weight of water displaced by the block

(C) A horizontal force exerted by the water pushing the block sideways

(D) The weight of the submerged block acting on the water below it

Q5. A cyclist inflates the bicycle tyres to the recommended pressure before a ride. Why is maintaining correct tyre pressure important?

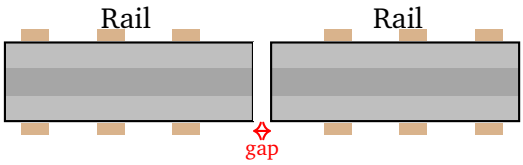
(A) To increase the contact area of the tyre with the road surface

(B) To reduce friction between the tyre and the road

(C) To maintain the correct internal air pressure for safe and efficient riding

(D) To make the tyre and bicycle lighter overall

Q6. The figure shows two railway rails placed end-to-end with a small gap between them at the joint. Why is this gap provided?



(A) To allow the tracks to contract and pull inward during cold winter months

(B) To reduce friction between the train wheels and the rails

(C) To provide electrical insulation between adjacent rail sections

(D) To allow the metal rails to expand in summer heat without buckling or bending

Q7. A student places a black metal plate and a white metal plate of the same size in sunlight for the same duration. She finds the black plate is much hotter. What does this tell us about heat absorption?

(A) Dark or black surfaces absorb heat radiation better than light or white surfaces

(B) Light or white surfaces absorb heat radiation better than dark or black surfaces

(C) The colour of a surface has no effect on how much heat radiation it absorbs

(D) Dark surfaces reflect more heat radiation than white surfaces do

Q8. A concave mirror is commonly used as a shaving mirror or make-up mirror. When an object is placed very close to such a mirror (within its focal length), what kind of image is formed?

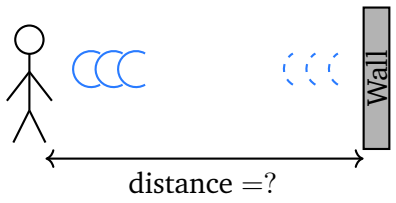
(A) A convex mirror always produces a magnified real image

(B) A concave mirror produces a virtual, magnified, and erect image when the object is inside the focal length

(C) A plane mirror produces a magnified image when used very close to the face

(D) A concave mirror always produces an inverted image regardless of the object's position

Q9. The figure shows a person facing a wall. For the person to hear a distinct echo of a sound they make, what is the **minimum distance** the wall must be from the person?



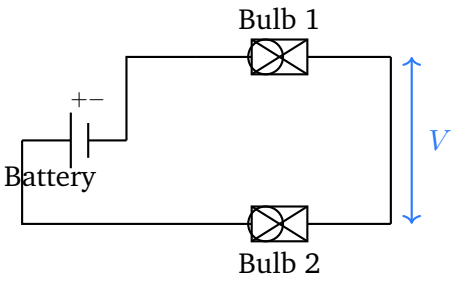
(A) At least 10 m, since sound needs to travel back and forth in 0.06 s

(B) At least 34 m, which is the total path length sound travels in 0.1 s

(C) At least 17 m, since sound travels 34 m in 0.1 s, and must go to the wall and back

(D) At least 5 m, because echoes are heard as soon as sound reflects off any surface

Q10. The figure shows two bulbs connected in a **parallel circuit** across a battery. What is true about the voltage across each bulb?



(A) The current is the same through each bulb, as in a series circuit

(B) The voltage is divided equally between the two bulbs

(C) The operation of one bulb affects the brightness of the other bulb

(D) The voltage across each bulb is equal to the supply voltage of the battery

Q11. Which of the following correctly describes the **pH scale**?

(A) A pH below 7 indicates an acidic solution, pH 7 is neutral, and pH above 7 is basic (alkaline)

(B) A pH below 7 indicates a basic solution, pH 7 is neutral, and pH above 7 is acidic

(C) Any solution with pH below 14 is acidic, while pH 14 indicates a neutral solution

(D) All aqueous solutions have a pH of exactly 7 at room temperature

Q12. What colour change does **phenolphthalein** indicator show when tested in an acidic solution and then in an alkaline solution?

(A) Red in acid, blue in base

(B) Colourless in acid (and neutral), pink in alkaline (basic) solution

(C) Yellow in acid, red in base

(D) Pink in acid, colourless in base

Q13. Which of the following is an example of a **decomposition reaction**?

(A) Iron reacts with oxygen in air to form iron(III) oxide (rust)

(B) Zinc displaces copper from copper sulphate solution

(C) Calcium carbonate ($CaCO_3$) decomposes on heating to give quicklime (CaO) and carbon dioxide (CO_2)

(D) Hydrogen burns in oxygen to form water

Q14. Which of the following lists metals in the **correct order** of decreasing reactivity (most reactive first)?

(A) Copper > Iron > Zinc > Aluminium > Magnesium > Sodium

(B) Iron > Zinc > Aluminium > Magnesium > Sodium > Copper

(C) Aluminium > Sodium > Magnesium > Zinc > Iron > Copper

(D) Sodium > Magnesium > Aluminium > Zinc > Iron > Copper

Q15. Iron is extracted from its ore, haematite. How is this extraction carried out on an industrial scale?

(A) By reduction using coke (carbon) in a blast furnace at very high temperatures

(B) By electrolysis of molten iron ore

(C) By simply heating the iron ore directly in air, which releases pure iron

(D) By the froth flotation process used to separate the ore from gangue

Q16. Carbon monoxide (CO) is a harmful, colourless, odourless gas. Under what condition is it produced?

(A) During the complete combustion of carbon-based fuels when excess oxygen is present

(B) During the incomplete combustion of carbon-based fuels when oxygen supply is limited

(C) When carbon dioxide reacts with water to form carbonic acid

(D) When carbon dioxide decomposes at very high temperatures

Q17. Water is said to have **temporary hardness** when it contains dissolved calcium and magnesium bicarbonates. Which method can be used to remove temporary hardness?

(A) By adding a small quantity of acid to neutralise the bicarbonates

(B) By passing the water through a fine membrane filter

(C) By boiling the water, which decomposes the soluble bicarbonates into insoluble carbonates that settle out

(D) By distillation — simple boiling alone cannot remove temporary hardness

Q18. The ozone (O_3) layer is found in the stratosphere. What is its main function?

(A) It absorbs harmful infrared radiation from the Sun, preventing global warming

(B) It is located in the troposphere and provides the oxygen we breathe

(C) It produces oxygen for living organisms through a photochemical reaction

(D) It absorbs harmful ultraviolet (UV) radiation from the Sun, protecting living organisms on Earth

Q19. Which of the following correctly defines **biodegradable materials**?

(A) Materials that can be broken down by microorganisms into simpler, harmless substances

(B) Materials that cannot be broken down by any means, including strong chemicals

(C) Only materials made from natural fibres such as wool or cotton

(D) Materials that dissolve readily in water and disappear completely

Q20. Wool is a natural fibre used to make warm clothing. From which source is wool obtained?

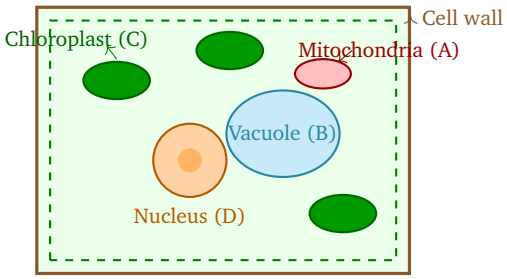
(A) From the cocoon spun by the silkworm (Bombyx mori)

(B) From the fleece (wool coat) of sheep, obtained by shearing

(C) From the stem fibres of the jute plant

(D) From the seed hair fibres surrounding the seeds of the cotton plant

Q21. The figure shows a simple plant cell. Which structure labelled in the figure is the **site of photosynthesis**, and why?



(A) Mitochondria, because they produce energy (ATP) for all cellular activities

(B) Vacuole, because it stores water and raw materials needed for photosynthesis

(C) Chloroplast, because it contains the green pigment chlorophyll and carries out photosynthesis

(D) Nucleus, because it controls all activities of the cell, including photosynthesis

Q22. Which of the following correctly describes the role of **salivary amylase** in digestion?

(A) Pepsin secreted in saliva begins the digestion of proteins in the mouth

(B) Lipase secreted in saliva begins the breakdown of fats in the mouth

(C) Salivary amylase breaks down proteins into amino acids in the mouth

(D) Salivary amylase (ptyalin) begins the breakdown of starch into maltose in the mouth

Q23. How does **aerobic respiration** compare to **anaerobic respiration** in terms of energy released from one molecule of glucose?

(A) Aerobic respiration releases far more energy (36–38 ATP per glucose) compared to anaerobic respiration (only 2 ATP)

(B) Anaerobic respiration releases more energy because it does not require oxygen, making the process faster

(C) Both aerobic and anaerobic respiration release exactly the same amount of energy per glucose molecule

(D) Aerobic respiration releases less energy because oxygen is consumed in the process

Q24. Blood is a connective tissue that transports materials throughout the body. Which of the following lists all four main components of blood?

(A) Only red blood cells and white blood cells

(B) Plasma, red blood cells (RBCs), white blood cells (WBCs), and platelets

(C) Plasma, red blood cells, and haemoglobin only (platelets are not a component)

(D) Serum, lymphocytes, and platelets only

Q25. Ginger and turmeric reproduce vegetatively through underground stem-like structures. What are these structures called?

(A) Bulbs, which are short stems surrounded by fleshy leaves (e.g., onion)

(B) Runners, which are long horizontal stems that grow along the ground (e.g., strawberry)

(C) Rhizomes, which are thick horizontal underground stems that produce new shoots and roots

(D) Tubers, which are swollen underground stems storing food (e.g., potato)

Q26. Some seeds are adapted for dispersal by wind. Which feature is most characteristic of wind-dispersed seeds?

(A) They are large and heavy, so they fall close to the parent plant and germinate quickly

(B) They have hooks or sticky surfaces that catch on the fur or feathers of animals

(C) They have air-filled outer coverings or hard shells that help them float in water

(D) They are very light and have feathery or wing-like structures that help them travel far on the wind

Q27. Fungi play an important role in the ecosystem. Which of the following best describes this role?

(A) Decomposers that break down dead organic matter by secreting digestive enzymes outside their body, recycling nutrients into the soil

(B) Producers that make their own food through photosynthesis using sunlight

(C) Strict parasites that only harm living organisms and cannot decompose dead matter

(D) Consumers that feed exclusively on living green plants

Q28. A doctor advises a patient suffering from influenza (a viral infection) **not** to take antibiotics. Why?

(A) Antibiotics are effective against both bacterial and viral infections

(B) Antibiotics have no effect on viruses; they only act against bacteria

(C) Antibiotics work better against viruses than they do against bacteria

(D) Antibiotics destroy all types of microorganisms including fungi and viruses as well as bacteria

Q29. Trees play an important role in preventing soil erosion. How do they achieve this?

(A) Deforestation increases the soil's ability to hold water, reducing erosion

(B) Tree leaves decompose and add nutrients that bind soil particles tightly together

(C) Tree roots hold soil particles together and the tree canopy softens the impact of rainfall, preventing erosion

(D) Deforestation has no effect on soil erosion; rain causes the same erosion with or without trees

Q30. Deforestation refers to large-scale clearing of forests. Which of the following is a consequence of deforestation?

(A) Loss of biodiversity due to habitat destruction only — other effects are negligible

(B) Increased soil erosion only, as tree roots are no longer present to hold the soil

(C) A rise in atmospheric CO_2 only, as trees that absorb CO_2 are removed

(D) All of the above — loss of biodiversity, increased soil erosion, disruption of the water cycle, and a rise in atmospheric CO_2

Detailed Solutions

Q1.

Solution

Concept: Speed of sound in different media: Sound is a mechanical wave that travels by compressing and expanding the particles of the medium. The closer and more tightly bound the particles, the faster sound travels.

Step 1: Compare the three states of matter:

- **Solids:** particles are very closely packed and strongly bonded — vibrations are transmitted very quickly. Speed of sound in steel ≈ 5100 m/s.
- **Liquids:** particles are close but not rigidly bound. Speed of sound in water ≈ 1500 m/s.
- **Gases:** particles are far apart and weakly interacting. Speed of sound in air ≈ 340 m/s.

Step 2: Order of speed: Solids $>$ Liquids $>$ Gases.

Why other options are wrong: Option (A) says gases are fastest — completely incorrect; gas particles are too far apart for rapid transmission. Option (B) says liquids are fastest — incorrect; solids are faster. Option (D) claims equal speed in all media — wrong; speed depends strongly on the medium.

Answer: (C) Go Back to Q1

Q2.

Solution

Concept: Types of motion: An object is in uniform motion when it covers equal distances in equal intervals of time, regardless of how small the time interval is. Its speed remains constant and its distance-time graph is a straight line.

Step 1: Identify the key feature of uniform motion — equal distance in equal time.

Step 2: Check each option:

- (A) Uniform acceleration means speed is changing — not uniform motion.
- (B) A curved distance-time graph means speed is changing — not uniform.
- (C) Increasing speed is accelerated motion, not uniform.
- (D) Equal distances in equal time intervals — this is exactly the definition of uniform motion.

Why other options are wrong: Options (A), (B), and (C) all describe non-uniform (accelerated) motion where speed changes with time.

Answer: (D) Go Back to Q2

Q3.

Solution

Concept: Newton's First Law — Inertia of Rest: Every object at rest tends to stay at rest unless acted upon by an external force. When the card is flicked away very quickly, the horizontal force acts on the card for only a tiny duration. The coin, having inertia of rest, does not move horizontally and simply falls straight down into the glass due to gravity.

Step 1: The force is applied to the card, not the coin. The duration of contact between coin and card is negligibly small when the card is flicked quickly.

Step 2: Because of inertia of rest, the coin remains stationary (no net horizontal force acts on it). Once the card is removed, gravity pulls the coin straight down into the glass.

Why other options are wrong: Option (B) Centripetal force is needed for circular motion — there is no circular motion here. Option (C) Friction between coin and card would act horizontally, but when the card is flicked fast enough, friction has no time to act on the coin. Option (D) Buoyancy is an upward force from a fluid — there is no significant buoyancy from air in this context.

Answer: (A) Go Back to Q3

Q4.

Solution

Concept: Archimedes' Principle: When an object is immersed in a fluid, it experiences an upward force (buoyant force or upthrust) equal to the weight of the fluid displaced by the object.

Step 1: The direction of the buoyant force is always **upward** — opposing the weight of the object which acts downward.

Step 2: The magnitude of the buoyant force = weight of fluid displaced = $\rho_{\text{fluid}} \times V_{\text{submerged}} \times g$.

Step 3: The figure shows the buoyant force arrow pointing upward and the weight arrow pointing downward — consistent with Archimedes' Principle.

Why other options are wrong: Option (A) says the force is downward — in-

correct; buoyancy always acts upward. Option (C) says horizontal force — fluids exert pressure in all directions, but the net upward component is what we call buoyancy. Option (D) describes the weight of the block on the water, not the buoyant force on the block.

Answer: (B) Go Back to Q4

Q5.

Solution

Concept: Pressure and its applications: Tyre inflation ensures that the air inside the tyre is at the correct pressure. Proper inflation is essential for safe load-bearing, efficient rolling, and avoiding tyre damage or blowouts.

Step 1: The inner tube of a tyre acts as a container for compressed air. The pressure of this air supports the weight of the bicycle and rider.

Step 2: Under-inflation means less internal pressure, causing the tyre to deform excessively under load. Over-inflation can cause bursting. The correct pressure keeps the tyre functioning safely.

Why other options are wrong: Option (A) talks about surface area — inflation does not change the tyre footprint in the relevant way; the question is about pressure. Option (B) friction is between the tyre rubber and road, not related to inflation pressure. Option (D) inflation does not make the tyre lighter.

Answer: (C) Go Back to Q5

Q6.

Solution

Concept: Thermal Expansion: Most solid materials expand when heated and contract when cooled. Railway tracks are made of steel, which expands significantly in hot weather. If no gap were left, the expanding rails would push against each other and buckle or bend, derailing trains.

Step 1: In summer, rising temperatures cause the steel rails to expand. If the rails were laid end-to-end without a gap, the only direction available for expansion would be sideways, causing the rails to curve (buckle).

Step 2: The gap (expansion joint) provides the room needed for the metal to expand safely. In winter, the rails contract back and the gap widens slightly.

Why other options are wrong: Option (A) says the gap is for winter contraction — the gap is there primarily so rails can expand in summer without buckling.

Option (B) friction between wheels and rails is unrelated to the track joint gap. Option (C) electrical insulation is not the purpose of a mechanical expansion gap.

Answer: (D) Go Back to Q6

Q7.

Solution

Concept: Radiation of heat: Different surfaces vary in their ability to absorb and emit thermal radiation. Dark or black surfaces are good absorbers (and good emitters) of heat radiation. Light or white surfaces are poor absorbers and good reflectors.

Step 1: The black plate absorbs more of the sun's radiation and converts it to heat — therefore it becomes much hotter.

Step 2: The white plate reflects most of the radiation and absorbs very little — it stays comparatively cooler.

Practical examples: Solar water heaters use black absorber plates. People in hot climates wear light-coloured clothing. Thermos flasks have silvered surfaces to reflect radiation.

Why other options are wrong: Option (B) reverses the relationship — white surfaces do not absorb more than black. Option (C) is incorrect; colour has a significant effect on radiation absorption. Option (D) is the opposite of what happens; dark surfaces absorb rather than reflect more radiation.

Answer: (A) Go Back to Q7

Q8.

Solution

Concept: Image formation by a concave mirror: The nature of the image formed by a concave mirror depends on the position of the object relative to the focal length (f) and centre of curvature ($C = 2f$).

Step 1: When the object is placed **between the pole and the focus** (object distance $< f$), a concave mirror produces an image that is:

- **Virtual** (behind the mirror, cannot be projected on a screen)
- **Erect** (same orientation as the object)
- **Magnified** (larger than the object)

Step 2: This is why concave mirrors are used as shaving and make-up mirrors — the face appears larger and upright.

Why other options are wrong: Option (A) is about a convex mirror, which always forms virtual, diminished, erect images — never magnified. Option (C) is wrong; a plane mirror forms a virtual, erect, same-sized image. Option (D) is wrong; a concave mirror forms an inverted image only when the object is beyond the focus.

Answer: (B) Go Back to Q8

Q9.

Solution

Concept: Echo: An echo is a reflected sound that is heard distinctly after the original sound. For the human ear to perceive an echo as separate from the original sound, the reflected sound must arrive at least **0.1 seconds** after the original.

Step 1: Speed of sound in air ≈ 340 m/s. In 0.1 s, sound travels:

$$d_{\text{total}} = 340 \times 0.1 = 34 \text{ m}$$

Step 2: This 34 m is the **total path** (from person to wall and back). So the minimum distance to the wall is:

$$d_{\text{wall}} = \frac{34}{2} = 17 \text{ m}$$

Why other options are wrong: Option (A) 10 m — the sound would return in $\frac{20}{340} \approx 0.059$ s, which is less than 0.1 s, so no distinct echo is heard. Option (B) 34 m is the total path length, not the one-way distance to the wall. Option (D) 5 m is far too short; the reflected sound returns in only 0.03 s, merging with the original sound.

Answer: (C) Go Back to Q9

Q10.

Solution

Concept: Parallel circuits: In a parallel circuit, all components are connected directly across the same two points (the same terminals of the source). Each branch has the full supply voltage across it, regardless of what the other branches are doing.

Step 1: In a parallel circuit, the voltage across each branch is equal to the EMF

(electromotive force) of the battery (ignoring internal resistance).

Step 2: This means Bulb 1 and Bulb 2 each operate at the full supply voltage. If one bulb is removed or fails, the other continues to glow normally.

Key distinction from series circuits: In a series circuit, the supply voltage is divided among all components; the current is the same through all.

Why other options are wrong: Option (A) describes a series circuit property (same current). Option (B) is wrong; voltage is NOT divided in a parallel circuit. Option (C) is wrong; parallel branches are independent — one branch does not affect another.

Answer: (D) Go Back to Q10

Q11.

Solution

Concept: The pH scale: The pH scale is a measure of the concentration of hydrogen ions (H^+) in a solution. It runs from 0 to 14.

Step 1: Interpret the scale:

- pH < 7: acidic (e.g., lemon juice $\approx$ pH 2, vinegar $\approx$ pH 3)
- pH $= 7$: neutral (e.g., pure water)
- pH > 7: basic/alkaline (e.g., baking soda $\approx$ pH 8.5, bleach $\approx$ pH 12)

Step 2: A lower pH number means a stronger acid; a higher pH number means a stronger base.

Why other options are wrong: Option (B) reverses the meaning — pH below 7 is acidic, not basic. Option (C) misinterprets the scale; pH 14 is the most strongly alkaline, not neutral. Option (D) is completely wrong; different solutions have widely different pH values.

Answer: (A) Go Back to Q11

Q12.

Solution

Concept: Acid-base indicators: Indicators are substances that change colour depending on whether the solution is acidic, neutral, or alkaline. Phenolphthalein is a synthetic indicator widely used in laboratories.

Step 1: Phenolphthalein colour changes:

- Acidic and neutral solutions: **colourless**
- Alkaline (basic) solutions: **pink** (or magenta)

Step 2: Compare with other indicators — litmus: red in acid, blue in base; methyl orange: red in acid, yellow in base. Phenolphthalein is unique in being colourless in acidic conditions.

Why other options are wrong: Option (A) describes litmus paper behaviour. Option (C) describes methyl orange in the wrong direction. Option (D) reverses phenolphthalein's behaviour — it is pink in base, not in acid.

Answer: (B) Go Back to Q12

Q13.

Solution

Concept: Types of chemical reactions: A decomposition reaction is one in which a single compound breaks down into two or more simpler products when energy (heat, light, or electricity) is supplied.

Step 1: Identify the type of each reaction:

- Option (A): $Fe + O_2 \rightarrow Fe_2O_3$ — two reactants combine: **combination reaction**
- Option (B): $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$ — **displacement reaction**
- Option (C): $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$ — one reactant gives two products: **decomposition reaction** ✓
- Option (D): $H_2 + O_2 \rightarrow H_2O$ — two reactants combine: **combination reaction**

Step 2: The equation for option (C):

$$CaCO_3 \xrightarrow{\text{heat}} CaO + CO_2$$

One compound (limestone) breaks into two simpler substances (quicklime and carbon dioxide).

Why other options are wrong: Options (A) and (D) are combination reactions (two or more reactants $\rightarrow$ one product). Option (B) is a displacement reaction (more reactive metal displaces a less reactive one).

Answer: (C) Go Back to Q13

Q14.

Solution

Concept: Reactivity (Activity) Series of metals: The reactivity series ranks metals from most reactive (top) to least reactive (bottom). More reactive metals displace less reactive metals from their salt solutions.

Step 1: The standard order (from most to least reactive for common metals):

$$\text{Na} > \text{Mg} > \text{Al} > \text{Zn} > \text{Fe} > \text{Cu} > \text{Ag} > \text{Au}$$

Step 2: Check option (D): Na $>$ Mg $>$ Al $>$ Zn $>$ Fe $>$ Cu — this matches the correct order exactly.

Why other options are wrong: Option (A) reverses the order completely, placing Cu (least reactive of those listed) first. Option (B) omits Na entirely and has an incorrect arrangement. Option (C) places Al above Na, which is wrong — sodium is more reactive than aluminium.

Answer: (D) Go Back to Q14

Q15.

Solution

Concept: Extraction of metals: The method used to extract a metal from its ore depends on the metal's position in the reactivity series. Iron (moderately reactive) is extracted by reduction using coke (carbon) in a blast furnace.

Step 1: The main ore of iron is haematite (Fe_2O_3). In a blast furnace, coke burns to form carbon monoxide:

$$\text{C} + \text{O}_2 \rightarrow \text{CO}_2 \quad \text{then} \quad \text{CO}_2 + \text{C} \rightarrow 2\,\text{CO}$$

Step 2: Carbon monoxide reduces iron oxide at high temperature:

$$Fe_2O_3 + 3\,CO \rightarrow 2\,Fe + 3\,CO_2$$

Molten iron is collected at the bottom of the furnace.

Why other options are wrong: Option (B) Electrolysis is used for highly reactive metals (Na, Mg, Al) that cannot be reduced by carbon. Option (C) Simply heating iron ore in air would produce iron oxide, not iron. Option (D) Froth flotation is a physical method of concentrating ores, not a method of extraction.

Answer: (A) Go Back to Q15

Q16.

Solution

Concept: Combustion and carbon monoxide: When carbon-based fuels burn in a **limited** (insufficient) supply of oxygen, the carbon does not get fully oxidised to CO_2. Instead, carbon monoxide (CO) is produced.

Step 1: Complete combustion (excess oxygen):

$C + O_2 \rightarrow CO_2$ (carbon dioxide — relatively harmless at low concentrations)

Step 2: Incomplete combustion (limited oxygen):

$$2\,C + O_2 \rightarrow 2\,CO \quad \text{(carbon monoxide — toxic)}$$

Danger: CO binds to haemoglobin in blood about 200 times more strongly than oxygen, preventing oxygen transport. This is why burning charcoal or running an engine in a closed room is deadly.

Why other options are wrong: Option (A) complete combustion produces CO_2, not CO. Option (C) CO_2 + H_2O forms carbonic acid (H_2CO_3), not CO. Option (D) CO_2 decomposition at very high temperatures is a different reaction.

Answer: (B) Go Back to Q16

Q17.

Solution

Concept: Hardness of water: Temporary hardness is caused by dissolved calcium bicarbonate $Ca(HCO_3)_2$ and magnesium bicarbonate $Mg(HCO_3)_2$. These are soluble, so the water cannot lather well with soap.

Step 1: When temporarily hard water is **boiled**, the soluble bicarbonates decompose:

$$Ca(HCO_3)_2 \xrightarrow{\text{boil}} CaCO_3\downarrow + H_2O + CO_2\uparrow$$

The insoluble calcium carbonate precipitates out, removing the hardness.

Step 2: After boiling and filtering, the water becomes soft and lathers well with soap.

Why other options are wrong: Option (A) Adding acid would dissolve the carbonates and worsen the problem, not remove hardness. Option (B) Filtration removes suspended particles but cannot remove dissolved ions causing hardness. Option (D) Distillation does remove hardness, but simple boiling also works for temporary hardness — the question asks what removes temporary hardness, and boiling is the direct, simple method.

Answer: (C) Go Back to Q17

Q18.

Solution

Concept: The ozone layer: The ozone layer is a region of the Earth's stratosphere (about 15–35 km above the surface) containing high concentrations of ozone (O_3). It acts as a shield against harmful radiation from the Sun.

Step 1: Ultraviolet (UV) radiation from the Sun is damaging to living cells. Prolonged exposure to UV radiation can cause:

- Skin cancer and cataracts in humans
- Damage to marine ecosystems (phytoplankton)
- Reduced crop yields

Step 2: The ozone layer absorbs most UV-B and UV-C radiation before it reaches Earth's surface:

$$O_3 + \text{UV photon} \rightarrow O_2 + O$$

CFCs and other pollutants deplete the ozone layer, creating the "ozone hole."

Why other options are wrong: Option (A) The ozone layer is not primarily an

infrared absorber; greenhouse gases (CO_2, water vapour) absorb infrared. Option (B) The ozone layer is in the **stratosphere**, not the troposphere. Option (C) The ozone layer does not produce oxygen for breathing; photosynthesis does.

Answer: (D) Go Back to Q18

Q19.

Solution

Concept: Biodegradable vs non-biodegradable materials: Biodegradable materials are those that microorganisms (bacteria, fungi) can decompose into simpler, harmless substances such as water, carbon dioxide, and humus.

Step 1: Examples of biodegradable materials: food scraps, vegetable peels, paper, cotton cloth, wood, jute, animal dung.

Step 2: Examples of non-biodegradable materials: most plastics, glass, metals, synthetic fibres (nylon, polyester). These accumulate in the environment and cause pollution.

Key point: The distinction is whether microorganisms can break the material down. Biodegradable waste can be composted; non-biodegradable waste must be recycled or disposed of carefully.

Why other options are wrong: Option (B) is the definition of non-biodegradable, not biodegradable. Option (C) is too narrow — many synthetic materials are non-biodegradable while not all natural fibres are; the defining criterion is microbial breakdown, not material source. Option (D) dissolving in water is a physical process, not the same as biodegradation.

Answer: (A) Go Back to Q19

Q20.

Solution

Concept: Natural fibres and their sources: Natural fibres come from plant or animal sources. Wool is an animal fibre obtained from the fleece (outer coat of hair) of sheep and some other animals such as goats (cashmere, mohair), alpacas, and llamas.

Step 1: Process of obtaining wool:

(a) Shearing: the sheep's fleece is cut off

(b) Scouring: the fleece is washed to remove grease and dirt

(c) Carding: fibres are separated and aligned

(d) Spinning: fibres are twisted into yarn

Step 2: Wool is a protein fibre (keratin) that provides excellent insulation — it traps air between fibres, keeping the wearer warm.

Why other options are wrong: Option (A) Silk comes from the cocoon of the silkworm (Bombyx mori) — it is an animal fibre but from an insect, not a mammal. Option (C) Jute is a plant fibre obtained from the stem of the jute plant (Corchorus species). Option (D) Cotton is a plant fibre obtained from the seed hairs of the cotton plant (Gossypium species).

Answer: (B) Go Back to Q20

Q21.

Solution

Concept: Plant cell organelles and photosynthesis: Chloroplasts are organelles found in the cells of green plants and algae. They contain the green pigment **chlorophyll**, which captures light energy for photosynthesis.

Step 1: Photosynthesis equation:

$$6\,CO_2 + 6\,H_2O \xrightarrow{\text{sunlight, chlorophyll}} C_6H_{12}O_6 + 6\,O_2$$

Carbon dioxide and water are converted into glucose (food) and oxygen inside the chloroplast.

Step 2: The label "(C) Chloroplast" in the diagram marks the oval green bodies visible in the plant cell.

Why other options are wrong: Option (A) Mitochondria are the sites of **cellular respiration** (breaking down glucose to release energy as ATP), not photosynthesis. Option (B) The vacuole stores cell sap (water, salts, sugars) and maintains turgor pressure; it does not carry out photosynthesis. Option (D) The nucleus controls cell activities and contains genetic material but does not directly carry out photosynthesis.

Answer: (C) Go Back to Q21

Q22.

Solution

Concept: Digestion of carbohydrates: Digestion of starch begins in the mouth. Saliva contains the enzyme **salivary amylase** (also called ptyalin), which hydrolyses (breaks down) starch into a simpler sugar, maltose.

Step 1: Chemical digestion in the mouth:

$$\text{Starch} \xrightarrow{\text{salivary amylase}} \text{Maltose (+ dextrin)}$$

Step 2: Salivary amylase is a carbohydrase — it acts specifically on the glycosidic bonds in starch. It does not act on proteins or fats.

Why other options are wrong: Option (A) Pepsin is a protease found in the stomach (in gastric juice), not in saliva. Option (B) Lipase (fat-digesting enzyme) is secreted by the pancreas and small intestine, not in saliva in significant amounts. Option (C) Proteins are digested by proteases such as pepsin (stomach) and trypsin (small intestine) — salivary amylase does not break proteins.

Answer: (D) Go Back to Q22

Q23.

Solution

Concept: Aerobic and anaerobic respiration: Both types of respiration release energy from glucose, but they differ greatly in efficiency (energy yield) and the products formed.

Step 1: Compare energy yields:

- **Aerobic respiration** (requires O_2, occurs in mitochondria):
  $C_6H_{12}O_6 + 6\,O_2 \rightarrow 6\,CO_2 + 6\,H_2O +$ **36–38 ATP**
- **Anaerobic respiration** (no O_2 required, occurs in cytoplasm):
  $C_6H_{12}O_6 \rightarrow 2\,C_2H_5OH + 2\,CO_2 +$ **2 ATP** (in yeast)
  $C_6H_{12}O_6 \rightarrow 2\,C_3H_6O_3 +$ **2 ATP** (in muscles — lactic acid)

Step 2: Aerobic respiration yields approximately 18 times more ATP per glucose molecule than anaerobic respiration. This is because aerobic respiration fully oxidises glucose through the Krebs cycle and electron transport chain.

Why other options are wrong: Option (B) is incorrect — anaerobic does not release more energy; it releases far less. Speed is not the same as energy yield. Option (C) is wrong; the energy yields are very different. Option (D) is wrong — aerobic respiration releases **more** energy, not less.

Answer: (A) Go Back to Q23

Q24.

Solution

Concept: Composition of blood: Blood is a fluid connective tissue. It has two main parts — the liquid portion (plasma) and the formed elements (cells and cell fragments).

Step 1: Four components of blood:

- **Plasma** ($\approx 55\%$): yellowish liquid containing water, proteins, hormones, nutrients, salts
- **Red blood cells (RBCs / Erythrocytes)**: contain haemoglobin; transport oxygen
- **White blood cells (WBCs / Leucocytes)**: part of the immune system; fight infections
- **Platelets (Thrombocytes)**: involved in blood clotting

Step 2: Haemoglobin is a protein **inside** RBCs, not a separate component of blood. Serum is plasma without clotting factors.

Why other options are wrong: Option (A) omits plasma and platelets — both are essential components. Option (C) lists haemoglobin as a separate component and omits platelets. Option (D) uses the term "serum" (incorrect for whole blood) and omits RBCs.

Answer: (B) Go Back to Q24

Q25.

Solution

Concept: Vegetative propagation: Plants can reproduce asexually through various vegetative parts. Different underground structures serve as vegetative propagules in different species.

Step 1: Identify the vegetative structure of ginger and turmeric:

- Ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*) reproduce through **rhizomes** — thick, fleshy, horizontal underground stems. Each rhizome node can produce new roots (downward) and shoots (upward).

Step 2: Distinguish from other vegetative structures:

- **Bulb**: a modified underground bud with fleshy scale leaves (onion, garlic)
- **Runner (stolon)**: a slender stem that grows horizontally on the ground surface (strawberry, grass)
- **Tuber**: a swollen, rounded underground stem storing starch (potato — has "eyes" which are axillary buds)

Why other options are wrong: Option (A) bulbs are structures like onions with fleshy leaves, not what ginger/turmeric use. Option (B) runners grow above ground, not underground. Option (D) tubers like potato are rounded and swollen, unlike the elongated, jointed rhizomes of ginger and turmeric.

Answer: (C) Go Back to Q25

Q26.

Solution

Concept: Seed dispersal by wind (Anemochory): For seeds to be dispersed by wind, they must be lightweight and have structures that increase air resistance, keeping them airborne long enough to travel far from the parent plant.

Step 1: Key adaptations for wind dispersal:

- **Feathery/hairy pappus**: dandelion seeds have a parachute of fine hairs (pappus) that let them float in wind
- **Wing-like extensions (samaras)**: maple, ash, and pine seeds have papery wings that cause them to spin and glide
- Small size and very low mass: reduces the effect of gravity

Step 2: The seeds of dandelion, maple, and similar plants are light and equipped with feathery or wing-like structures — matching option (D).

Why other options are wrong: Option (A) large, heavy seeds (like coconuts or acorns) fall close to the parent plant — not wind dispersed. Option (B) hooks and sticky surfaces are adaptations for dispersal by animals (zoochory, e.g., Xanthium, grass burrs). Option (C) air-filled coverings and buoyancy are adaptations for water dispersal (hydrochory, e.g., coconut).

Answer: (D) Go Back to Q26

Q27.

Solution

Concept: Role of fungi in the ecosystem: Fungi are heterotrophic organisms that cannot make their own food. The majority of fungi are **saprotrophic decomposers** — they obtain nutrition by breaking down dead and decaying organic matter.

Step 1: How fungi decompose matter:

- Fungi secrete digestive enzymes **outside their body** into the surrounding dead material.
- These enzymes break complex organic molecules (cellulose, proteins, fats) into simpler soluble molecules.
- The fungi then absorb these simpler molecules as food.

Step 2: Importance of fungal decomposition: Nutrients locked in dead organisms are released back into the soil, making them available for plants. This nutrient cycling is essential for ecosystem health.

Examples: Mushrooms decomposing a fallen log; bread mould (Rhizopus) on stale bread; Aspergillus and Penicillium in soil.

Why other options are wrong: Option (B) Producers (like green plants and algae) make food via photosynthesis — fungi lack chlorophyll. Option (C) While some fungi are parasitic (e.g., Aspergillus causing disease), the majority are saprotrophic decomposers, not strict parasites. Option (D) Fungi do not eat living plants; they decompose dead organic matter.

Answer: (A) Go Back to Q27

Q28.

Solution

Concept: Antibiotics and their limitations: Antibiotics are chemical substances (produced by microorganisms or synthesised) that kill or inhibit the growth of bacteria. They target bacterial cell walls, ribosomes, or metabolic pathways that are absent or different in human cells.

Step 1: Viruses are fundamentally different from bacteria:

- Viruses are not cells — they are non-living particles consisting of genetic material (DNA or RNA) enclosed in a protein coat.
- Viruses use the host cell's machinery to replicate; they have no cell walls, no

ribosomes of their own, and no independent metabolism.

Step 2: Because antibiotics target bacterial-specific structures (e.g., bacterial cell wall, bacterial ribosomes), they have **no effect on viruses**. Viral infections (influenza, common cold, COVID-19) are treated with antiviral drugs, not antibiotics.

Important note: Misusing antibiotics for viral infections contributes to antibiotic resistance — a serious global health problem.

Why other options are wrong: Option (A) is incorrect — antibiotics do not work against viruses. Option (C) reverses the truth; antibiotics work against bacteria, not viruses. Option (D) is incorrect; antibiotics do not destroy viruses or fungi (antifungal drugs are used for fungi).

Answer: (B) Go Back to Q28

Q29.

Solution

Concept: Trees and soil conservation: Forests play a vital role in preventing soil erosion through two main mechanisms involving roots and the tree canopy.

Step 1: How trees prevent soil erosion:

- **Roots:** Tree roots penetrate deep into the soil and spread widely, physically binding soil particles together. This creates a network that holds the topsoil in place even during heavy rain or strong winds.
- **Canopy (leaf cover):** The tree canopy intercepts rainfall, breaking the force of raindrops before they hit the soil. Unbroken rainfall can dislodge soil particles (called "splash erosion").
- **Leaf litter:** Fallen leaves on the forest floor slow down surface water runoff, giving water time to soak in rather than wash soil away.

Step 2: When forests are cleared (deforestation), the soil is left bare, unprotected roots die, and topsoil is rapidly washed away by rain and blown away by wind.

Why other options are wrong: Option (A) reverses the effect — deforestation reduces, not increases, the soil's water-holding capacity. Option (B) nutrient addition from leaf litter is a secondary benefit; the primary anti-erosion mechanism is root binding and canopy protection. Option (D) is factually wrong; trees significantly reduce erosion.

Answer: (C) Go Back to Q29

Q30.

Solution

Concept: Consequences of deforestation: Forests perform multiple critical functions for the environment. Removing large areas of forest has wide-ranging negative consequences, not just one.

Step 1: Major consequences of deforestation:

- **Loss of biodiversity:** Millions of species depend on forest habitats. Clearing forests destroys their homes, leading to local extinction and loss of genetic diversity.
- **Increased soil erosion:** Without tree roots to bind the soil and canopy to soften rain impact, topsoil is rapidly washed away (as explained in Q29).
- **Disruption of the water cycle:** Trees release water vapour through transpiration, contributing to rainfall. Deforestation reduces transpiration, leading to changes in rainfall patterns and increased desertification.
- **Rise in atmospheric CO_2:** Trees absorb CO_2 during photosynthesis. Cutting trees releases stored carbon back into the atmosphere and removes the CO_2-absorbing capacity, intensifying the greenhouse effect and global warming.

Step 2: Since all the consequences listed in options (A), (B), and (C) are real effects of deforestation, option (D) — "all of the above" — is correct.

Why other options are wrong: Options (A), (B), and (C) each identify only one consequence of deforestation as if it were the only one. Deforestation is a multi-dimensional environmental problem, and all the listed consequences occur simultaneously.

Answer: (D) Go Back to Q30

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	D	3	A	4	B	5	C
6	D	7	A	8	B	9	C	10	D
11	A	12	B	13	C	14	D	15	A
16	B	17	C	18	D	19	A	20	B
21	C	22	D	23	A	24	B	25	C
26	D	27	A	28	B	29	C	30	D